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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/589,680

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Masashi Nakabayashi

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EXAMINER

LANGMAN, JONATHAN C

ART UNIT

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/589,680	Applicant(s) NAKABAYASHI ET AL.	
	Examiner JONATHAN C. LANGMAN	Art Unit 1794	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 September 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) 21-28 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20, 29 and 30 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date <u>9/18/2009</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

Applicant's election without traverse in the reply filed on August 17, 2009 is acknowledged.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 13, 14, 29, and 30 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The applicant amended the claims to include resistivities of at least 1×10^{10} ohm-cm and not less than 1×10^{11} ohm-cm. The applicant points to table 1 for support. However the Examiner can not find and the applicant has not shown in the originally filed specification that they were in possession of the specifically claimed endpoints. Applicant has not shown that they were in possession of the endpoints of 1×10^{10} ohm-cm and 1×10^{11} ohm-cm, and furthermore has not shown that they were in possession of all resistivities greater than 1×10^{11} ohm-cm.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 4-7, 11-14, and 29-30, are rejected under 35 U.S.C. 102 (b) as being anticipated by, or in the alternative, rejected under 35 U.S.C. 103(a) as being unpatentable over Jenny et al. (“Deep Level Transient spectroscopic and Hall Effect Investigation of the position of The Vanadium Acceptor Level in 4H and 6H-SiC”).

Jenny et al. teach doping SiC with Vanadium and Nitrogen (pg 1963, c. 1, pp. 3). The amount of uncompensated Nitrogen is 1.5×10^{18} (pg. 1965, c.1, pp.1). The Vanadium concentration was $3.0 \times 10^{17} \text{ cm}^{-3}$, which encompasses those ranges taught in instant claims 5-7 (pg. 1965, c.1, pp.1). This value of vanadium is less than that of the uncompensated nitrogen concentrations. Uncompensated Nitrogen is N-type. The SiC Crystals are 4H and 6H.

Jenny et al. are silent to the making the difference in concentrations of said uncompensated impurity and said Vanadium to be one such that the single crystal has an electrical resistivity at room temperature of at least $1 \times 10^5 \text{ ohm-cm}$ or $1 \times 10^{10} \text{ ohm-cm}$ and $1 \times 10^{11} \text{ ohm-cm}$. However, it is inherent that the SiC crystals of Jenny will possess the same electrical resistivity.

Where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of either anticipation or obviousness has been established. MPEP 2112.01. Moreover, the Patent and Trademark Office can require an applicant to prove that the prior art products do not necessarily or inherently possess the characteristics of the claimed product. Whether the rejection is based on "inherency" under 35 U.S.C. § 102, or "prima facie obviousness" under 35 U.S.C. § 103, jointly or alternatively, the burden of proof is the same, and its fairness is evidenced by the inability of the Patent and Trademark Office to manufacture products or obtain and compare prior art products. *In re Best*, 562 F.2d 1252, 1255 (CCPA 1977).

The mere recitation of a newly discovered property, inherently possessed by things in the prior art, does not cause a claim drawn to those things to distinguish over the prior art. *In re Swinehart*, 439 F.2d 210, 212-13 (CCPA 1971).

Jenny teaches concentrations that substantially overlap those ranges instantly claimed, and furthermore teach the same materials as instantly claimed and taught. Therefore it is the examiners position that these concentrations that have the instantly claimed differences in concentrations will inherently yield a silicon carbide single crystal which possesses an electrical resistivity at room temperature of at least 1×10^5 ohm cm, 1×10^{10} ohm-cm and 1×10^{11} ohm-cm, as presently claimed.

Claim Rejections - 35 USC § 103

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The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-18, 29 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carter Jr. et al. (US 2001/0023945).

Regarding claims 1-9, 13, 14, 29, and 30, Carter Jr. et al. teach a Silicon carbide single crystal containing an impurity (nitrogen) in an atomic number density of less than 1×10^{17} and preferably in an amount of less than 5×10^{16} . Carter Jr. et al. go on to teach that vanadium is also present in an amount of less than 1×10^{16} , which is less than the amount of nitrogen ([0042]). Carter teaches that by using Nitrogen in such a small amount, there is no need to compensate the nitrogen dopants (uncompensated nitrogen) ([0046]). Uncompensated nitrogen is n-type.

Carter et al. are silent to the room temperature resistivity being $1 \times 10^{17} \text{ cm}^3$, and to controlling the amount difference in concentrations of the uncompensated impurity and vanadium in order to achieve this electrical resistivity.

However, Carter et al. teach ranges of uncompensated impurity concentrations and vanadium concentrations, similar to those ranges instantly claimed and taught. Discovering an optimum working range from within these disclosed ranges only takes routine skill in the art. A routineer in the art would have been motivated based on the teachings of Carter et al. to try concentrations of uncompensated impurities and vanadium, in amounts of 5×10^{16} and $1 \times 10^{16} \text{ atoms/cm}^3$, respectively. These

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amounts are disclosed working ranges and it is the examiners position that choosing from these ranges only involves routine skill in the art and would have been obvious to a routineer in the art in order to obtain desired electrical properties.

Generally, differences in concentration or temperature will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such concentration or temperature is critical. “[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.” In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). It has also been held that the normal desire of scientists or artisans to improve upon what is already generally known provides the motivation to determine where in a disclosed set of percentage ranges is the optimum combination of percentages.”); In re Hoeschele, 406 F.2d 1403, 160 USPQ 809 (CCPA 1969).

Therefore the general conditions of the instant claims are disclosed in the prior art of Carter et al. and it is the examiners position that discovering optimum or workable ranges would only involve routine experimentation. The obvious ranges disclosed above satisfy those ranges disclosed in instant claims 1-9.

Carter et al. only teach obtaining a maximum electrical resistivity of 0.5×10^5 ohm-cm, and does not disclose resistivities of at least 1×10^5 ohm-cm, 1×10^{10} ohm-cm, 1×10^{11} ohm-cm, as disclosed in claims 1, 13, 14, 29, and 30. However it is the Examiners position that the obvious workable ranges taught above will inherently result in the instantly claimed ranges of electrical resistivities.

Carter teach the use of sublimation recrystallization for the growth of SiC ([0040]-[0042]). Since Carter teaches similar methods to those instantly taught as well as similar materials, it is expected that the resulting crystals will have the same material characteristics and properties. It has been held that where the claimed and prior art products are identical or substantially identical in structure or are produced by identical or a substantially identical processes, a *prima facie* case of either anticipation or obviousness will be considered to have been established over functional limitations that stem from the claimed structure. *In re Best*, 195 USPQ 430, 433 (CCPA 1977), *In re Spada*, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). The ***prima facie*** case can be rebutted by evidence showing that the prior art products do not necessarily possess the characteristics of the claimed products. *In re Best*, 195 USPQ 430, 433 (CCPA 1977).

A material and its properties are inseparable. Since Carter et al. teach the same methods of sublimation recrystallization, and also teach a routineer in the art to obtain the obvious amounts of uncompensated impurities being 5×10^{16} atoms/cm³, and the obvious amounts of vanadium being 1×10^{16} atoms/cm³, it is inherent, absent the applicant providing evidence stating otherwise, that the SiC wafer of Carter et al. will possess the same electrical resistivities as instantly claimed (i.e. 1×10^5 ohm-cm, 1×10^{10} ohm-cm, 1×10^{11} ohm-cm).

These obviously modified concentrations of Vanadium and the uncompensated impurities are disclosed ranges taught by Carter et al. Even though Carter et al. teaches that vanadium is preferably less than 1×10^{14} atoms/cm³, the non preferred embodiments (of less than 1×10^{16}) are nevertheless disclosed and even though they

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are not preferred ranges would still have been obvious to a routineer in the art. "The use of patents as references is not limited to what the patentees describe as their own inventions or to the problems with which they are concerned. They are part of the literature of the art, relevant for all they contain." *In re Heck*, 699 F.2d 1331, 1332-33, 216 USPQ 1038, 1039 (Fed. Cir. 1983) (quoting *In re Lemelson*, 397 F.2d 1006, 1009, 158 USPQ 275, 277 (CCPA 1968)). A reference may be relied upon for all that it would have reasonably suggested to one having ordinary skill the art, including nonpreferred embodiments. *Merck & Co. v. Biocraft Laboratories*, 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied, 493 U.S. 975 (1989).

Regarding claim 10, Carter fails to teach the specific relationship instantly claimed in instant claim 10. However, for reasons stated above, it would have been obvious for a routineer in the art to use those ranges instantly claimed, as they fall within the workable and disclosed ranges of the prior art. The applicant is merely discovering and optimizing workable ranges. These instantly taught ranges are for the most part taught in Carter and would have been obvious modifications over Carter, to one of routine skill in the art.

Regarding claims 11, 12, 15, and 16, Carter Jr teach that the Sic may be 3C, 4H, or 6H crystal ([0035]). The act of polishing is a process limitations given little to no patentable weight. The applicant has not claimed any particular surface roughness, therefore any wafer will read on the claim as presented. Alternatively, even if "processing and polishing" were to be given patentable weight it is known in the art that

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SiC is not immediately used after slicing, but instead is cleaned and polished to prepare a more favorable surface for epitaxial growth.

Regarding claims 17, and 18, Carter teaches that a large diameter Sc is desirable ([0006]) however is silent to a diameter of the single crystal. Choosing a diameter to include those instantly claimed is well within the skill and obvious to a routineer in the art of microelectronic device building.

Claims 19 and 20, are rejected under 35 U.S.C. 103(a) as being unpatentable over Carter (US 2001/0023945) as applied above, in view of Faillon et al. (US 6,522,080).

Carter teach using Sic in microwave device field effect transistors, however do not specifically teach the epitaxial growth of GaN or SiC on top of the semi insulating SiC substrates ([0003]-[0007])). However these growth techniques and layers are known in the art of field effect transistors as evidenced by Faillon et al. (see abstract and col. 7, lines 17-25). It would have been obvious to a person having ordinary skill in the art at the time the present invention was made to epitaxial grow SiC or GaN on to the semi insulating SiC substrates of Carter et al. in order to build a known field effect transistor device in the art.

Response to Arguments

Applicant's arguments with respect to the rejections over Jenny have been considered but are moot in view of the new ground(s) of rejection.

The applicant amended the claims in order to recite a specific resistivity that is greater than those taught by Carter Jr. et al. The applicant argues that this is the patentable distinction between the prior art of Carter et al. and the instant invention.

However, it is the Examiners position, that Carter et al. teach overlapping ranges of concentrations for vanadium and uncompensated impurities in SiC, to those ranges instantly claimed. It is the Examiners position that discovering and optimizing the workable ranges of Carter, to include those ranges instantly claimed, involves only routine skill in the art. Generally, differences in concentration or temperature will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such concentration or temperature is critical. "[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). Therefore the general conditions of the instant claims are disclosed in the prior art of Carter et al. and it is the examiners position that discovering optimum or workable ranges would only involve routine experimentation. The obvious ranges disclosed above satisfy those ranges disclosed in instant claims 1-9.

These obvious ranges are the same as instantly claimed, and would inherently result in the electrical resistivities instantly claimed (see rejection above and in re best case law).

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The mere recitation of a newly discovered property, inherently possessed by things in the prior art, does not cause a claim drawn to those things to distinguish over the prior art. In re Swinehart, 439 F.2d 210, 212-13 (CCPA 1971).

Where the difference between the claimed invention and the prior art is some range or other variable within the claims, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range. In re Woodruff, 919 F.2d 1575, 1578 (Fed. Cir. 1990); see also In re Peterson, 315 F.3d 1325, 1329 (Fed. Cir. 2003) ("In cases involving overlapping ranges, we and our predecessor court have consistently held that even a slight overlap in range establishes a *prima facie* case of obviousness.").

The Examiner found that Carter discloses SiC doped with uncompensated impurities and vanadium to include overlapping ranges to those instantly claimed. Since Carter teaches the same materials and the same process of sublimation recrystallization, it is the Examiners position that the SiC crystal with the obviously modified and overlapping ranges of concentrations will inherently possess the instantly claimed electrical resistivity.

The applicants have not shown that these obvious ranges do not inherently possess these electrical resistivities, nor has the applicant shown that the claimed ranges will achieve unexpected results relative to the prior art range.

The applicant argues that Carter et al. teach that vanadium is either absent or if present, is present in amounts below those which will substantially affect the resistivity

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of the crystal preferably below 1×10^{16} atoms/cm³. The Examiner agrees, however, the range of 1×10^{16} atoms/cm³ overlaps that of the instant claims 5, 6, and 7. Even though these concentrations may be non preferred embodiments, they are none the less disclosed as workable ranges, and it would still be obvious for a routineer in the art to choose from these workable ranges.

For these reasons the rejections of record are maintained.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JONATHAN C. LANGMAN whose telephone number is (571)272-4811. The examiner can normally be reached on Mon-Thurs 8:00 am - 6:30 pm EST.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer McNeil can be reached on 571-272-1540. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JCL

/Timothy M. Speer/

Primary Examiner, Art Unit 1794